(b) generating a substantially similar imaging pulse and collateral pulse energy sequence for substantially each transmit line in a scanned region including at least eight transmit lines; and

(c) sampling energy responsive to each transmitted pulse.

Please cancel claim 17.

REMARKS

The amendments to the rewritten claims are shown in the attached Appendix. In the Appendix, additions are underlined and deletions are indicated with brackets.

In the Office Action, the Examiner rejected claims 1-10 pursuant to 35 U.S.C. §101 as non-statutory subject matter. Claims 11-33 were rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over Clark (U.S. Patent No. 5,980,458) in view of Poland (U.S. Patent No. 6,080,107) or over Hwang (U.S. Patent No. 6,193,662) in combination with Averkiou et al. (U.S. Patent No. 6,186,950). Claims 34-38 were rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over Averkiou et al. or Hwang et al. (U.S. Patent No. 6,228,031). Applicants respectfully request reconsideration of claims 1-38, including independent claims 1, 11, 21, 27, 29 and 34.

Claims 1-10 have been amended to clarify that the sequence is part of a method of transmitting. Claims 1-10 claim statutory subject matter.

The pulse sequence limitation of some of the independent claims was also amended to more clearly indicate the pulses or energy considered as part of the pulse sequence. These amendments clarify the pulse sequence term already in the claims, so do not narrow the claims. Likewise, the amendments adding at least eight scan lines clarify the meaning of scanned region.

Claim 1 requires a substantially similar energy sequence for each of at least eight scan lines where the energy sequence includes a collateral energy pulse between two imaging pulses. None of the cited references disclose these.

Clark teaches an interleave transmit sequence of A1, B1, C1, A2, B2, C2, A3, B3, C3 and so on (col. 2, lines 35-44) where A, B and C are the scan lines and 1, 2 and 3 are the transmission number along that scan line. Further cited disclosure of Clark does not provide for another specific sequence. Using the sequence of Clark, each scan line A, B and C is subjected to a different energy or pulse sequence. Scan line A receives Ce Ce Ce; scan line B receives eCeeCeeCe and scan line C receives eC eC eC where "C" represents energy from an imaging pulse on the scan line and "e" represents energy from an imaging pulse along an adjacent scan line. Scan line C may receive additional collateral energy depending on the meaning of "and so on." Repeating this interleave sequence for other scan lines (e.g. D, E and F) merely results in continuing to introduce an artifact from differences in energy sequences, so does not result in substantially the same energy or pulse sequence. For example, scan line C would then receive eC eC eCe e e, still different than A and B. Clark does not disclose a substantially similar energy sequence for each of at least eight scan lines where the energy sequence includes a collateral energy pulse between two imaging pulses.

Poland, unlike Clark, discloses contrast agent imaging. Poland does not teach specific transmit sequences, so does not disclose a substantially similar energy sequence for each of at least eight scan lines where the energy sequence includes a collateral energy pulse between two imaging pulses.

Hwang '662 discloses various transmit sequences with a flow sample interleave ratio of one (see Figures 1-4). The pulses for each transmitted scan line are sequentially transmitted before transmitting along another scan line. Multiple receive scan lines are formed for each transmit line. Further sets of information may be formed by interpolating between received scan lines. The Examiner notes that the distinction between interleaved and collateral pulses in relation to scan lines is blurred because the interpolated lines are also referred to as scan lines. However, claim 1 is a sequence of transmit pulses where the energy sequence is for each transmit scan line. Hwang '662 does not suggest a substantially similar energy sequence for

each of at least eight transmit scan lines where the energy sequence includes a collateral energy pulse between two imaging pulses.

The cited disclosure of Averkiou et al. teaches a time interleaved contrast agent imaging transmit sequence (col. 7, lines 6-32). Transmit pulses along four adjacent scan lines are fired. This sequence is then repeated once or twice more for the same four scan lines using any of various phasing of the transmit waveforms. If the same sequence is then repeated for transmit scan lines 5-8, 9-12 . . ., the imaging and collateral energy sequence varies between transmit scan lines. Averkiou et al. do not teach repetition or how to repeat the sequence across the region. Averkiou et al. do not teach how to scan an entire region or more than four scan lines, so Averkiou et al. do not suggest a substantially similar energy sequence for each of at least eight transmit scan lines where the energy sequence includes a collateral energy pulse and imaging pulses.

Claim 11, like claim 1, requires generating a substantially similar transmit pulse sequence for substantially each line in a scanned region of at least eight scan lines where the transmit pulse sequence includes energy from collateral pulses and imaging pulses on each line. As discussed above, none of the cited references disclose this limitation.

Claim 21, similar to claim 11, requires repeating three transmissions along two scan lines for different sets of scan lines such that a substantially same sequence of collateral and imaging pulses is provided for each of the scan lines. Clark and Averkiou et al. teach a single sequence for multiple lines, but do not disclose repeating the sequence for other lines where the sequence is substantially the same for each of the scan lines in both different sets. If merely repeated for different sets, then the sequences of both Clark and Averkiou et al. provided for different collateral and imaging pulse sequences for different scan lines. As previously discussed with respect to claim 1, Poland does not suggest specific transmit sequences. Hwang '662 discloses in the Figures transmitting without interleaving, so does not suggest the claimed transmission sequence.

Claim 27 requires using a flow sample interleave ratio greater than one for generating a substantially similar imaging pulse and collateral pulse energy sequence for substantially each transmit line in a scanned region including at least eight scan lines. Clark provides different imaging and collateral pulse energy sequences for different transmit lines. Poland does not suggest specific transmit sequences. Hwang '662 does not suggest a flow sample interleave ratio greater than one for transmit scan lines. Averkiou et al. do not provide a substantially similar imaging pulse and collateral pulse energy sequence for each transmit line in a region including at least eight scan lines.

The dependent claims 2-10, 12-16, 18-20, 22-26 and 28 depend from the independent claims discussed above. Accordingly, these dependent claims are allowable for the reasons discussed above for the independent claims. Further limitations of the dependent claims distinguish these claims from the cited references. For example, none of the references disclose: a flow sample interleave ratio that is equal to an integer multiple of a flow sample count minus one as claimed in claims 2, 10, 12, 18, 22, 26 and 28; or the specific combinations of flow sample interleave ratio and flow sample count as claimed in claims 4-9, 14-16 and 23-25.

Claim 29 requires replacing signals of one scan line with signals of another scan line based on a comparison of an intensity with a value. The cited disclosure of Clark discloses parallel artifacts, but suggests filtering and transmit changes to generate images without these parallel artifacts (col. 4, line 10-col. 6, line 9). Clark contemplates application to an entire image, so does not suggest comparison and replacement based on the comparison.

Poland determines a concentration of contrast agent and adjustment of characteristics of the acoustic imaging signals based on the concentration (col. 4, lines 6-15). For example, the receive signal amplitude is reduced or the transmit power is changed (col. 4, lines 15-24). Depletion transmissions may be used to control the concentration of contrast agent (col. 5, line 63-col. 6, line 29). Poland does not suggest replacing signals of one scan line with signals of another scan line based on a comparison.

Hwang '662 discloses pulse inversion scanning (col. 2, lines 33-40). Data for different receive scan lines of opposite phase are combined (col. 3, lines 4-16). For interpolated lines, axial re-sampling or filtering is used to remove an artifact (col. 6, lines 19-55). In one embodiment, multi-line interpolation motion artifact is avoided by using a transmit sequence (col. 10, lines 13-28). The Examiner does not cite to disclosure by Hwang '662 of any replacement of data based on a comparison.

Averkiou et al. disclose a motion artifact resulting from using two transmissions to a same area (col. 3, lines 1-48). To address this motion artifact, Averkiou et al. transmit at least one further pulse (col. 3, lines 49-56). The signals responsive to the three pulses are then combined for imaging (col. 4, lines 8-28). Averkiou et al. use three or more transmissions for reducing the motion artifact, so do not suggest replacing signals of one scan line based on a comparison. Furthermore, a user of the system in a two pulse mode would not compare the intensities to a value in order to switch to the three pulse mode. Averkiou et al. do not suggest the limitations of claim 29.

Claim 34, similar to claim 29, requires identifying signals associated with an image artifact and replacing the signals as a function of signals responsive to contrast agents. As discussed above, Averkiou et al. use a specific process to avoid artifacts, so do not suggest replacing signals associated with artifacts. Where a user switches between modes, signals are not replaced. Instead, different imaging is performed.

Hwang et al. '031 disclose avoiding a picket fence artifact by filtering or averaging received scan line data (col. 4, lines 41-54). The system does not identify an artifact and then replace signals. A user switching between modes due to viewing an artifact does not cause replacement of signals, but merely sets up different imaging.

CONCLUSION:

Applicants respectfully submit that all of the pending claims are in condition for allowance and seeks early allowance thereof. If for any reason, the Examiner is unable to allow the application but believes that an interview would be helpful to resolve any issues, he is respectfully requested to call Henry Groth at (650) 943-7350 or Craig Summerfield at (312) 321-4726.

Respectfully submitted,

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